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THE recent discussions at the Institute of Architects, on the arrangement of buildings with a view to the transmission of sound, afforded striking evidence of the want of positive information on the subject, which still exists, and leads constantly to annoyances and difficulties. Considerable interest was exhibited on the occasions in question; instances of the inconvenience resulting from the indefinite state of our knowledge in respect of sound were given, and of the great importance of improving it. Since the appearance of our reports of those discussions, we have received statements of various buildings (churches and large rooms), wherein the speaker or music, as the case may be, cannot be heard, with inquiries for advice,—shewing still further the extent of the demand for some effort to lay down accurate rules.

The first step towards effecting this, would be a collection of facts, obtained by rigorous investigation of a number of buildings; and we would suggest to the Institute that they should endeavour to organize a qualified committee forthwith to commence this investigation. If this were done, and the inquiry were properly conducted, good could not fail to result. Nothing, however, must be taken for granted. No dependence must be placed on reports that this is a good room or this a bad room for hearing; the fact must be ascertained personally; and the dimensions, shape, materials, mode of ventilating, and other circumstances, be then carefully recorded and weighed. "There is no point of natural science,"—said Mr. Wilson Croker to a committee of the House of Commons, appointed in 1831 to inquire as to the erection of new Houses of Parliament,—"that has been brought to so little practical certainty as that which is called *catacoustics*, or the doctrine of reflected sound: and *facts therefore are the more precious*." Facts are what we need; a body of carefully collected and well-arranged facts,—the result of which would be, SCIENCE.

It is distressing to read the contradictory opinions, which were given in evidence to this committee by architects and others of high standing. The circular is the best form; turn over a page and it is the worst.* The ceiling ought to be perfectly smooth and flat; no, it should be coved, and quite smooth; no, again, the surface of it should be broken up. You must have projections and breaks, says one, to prevent echo; "the reason that so many buildings fail," says another, "is by large projections and angles internally, which break the line of conduction, and reflect the sound in various directions, not co-operating with, but thwarting each other; or large and deep recesses in the walls and ceilings sometimes swallow up the sound or embay it." There is, nevertheless, something to be learnt from the evidence in question; and an abstract of all in it that relates to sound would be useful as well as curious.

The circumstance that at this moment, there is no one able to predicate with certainty the effect of any proposed building in respect of sound seems extraordinary, but is nevertheless undeniable; no one even pretends that he can do so, but all confess that the question is most difficult, and has not yet been properly investigated. Surely it is time to attempt it.

Three important buildings are now on the eve of completion, the value of which will depend *entirely* on their excellence in respect of the transmission of sound,—we mean the new House of Lords, St. George's Hall, Liverpool, and the Opera House, Covent Garden. In two, at all events, of these buildings, great consideration has been given to the question; nevertheless the issue is quite doubtful. We wait with some anxiety the resolution of the doubt. The ceiling of the new Opera House is domical, consisting of two ellipses, and is formed wholly of thin battens nailed to fir ribs,—an admirable piece of workmanship by the way,—apparently better adapted for music than for speaking.

The best form of ceilings is a question on which there is considerable difference of opinion. We have before us the notes of a lecture on acoustics delivered by Mr. Robert Addams (who has given attention to the subject), some years ago. Our readers will probably think the following portion of them worth printing:—He said, "If we looked to our churches, chapels, and school-rooms, almost all were bad; *the curved form of the ceilings reflected the voice of the speaker to a certain point*, and while one person was overpowered with sound, the majority of the congregation could not hear a word distinctly; and he was not a little apprehensive, that from the want of proceeding on scientific principles, many new buildings would be spoiled in the same manner. The form of room that was adapted for music would be bad for public speaking, and *vice versa*; therefore, architects should never attempt to combine the two objects in the same building. They required a certain degree of echo for music; but the great effort should be to get rid of all reverberation in a room intended for public speaking. Having heard his objections to public buildings as they were at present constructed, they would naturally feel disposed to ask the form of room he was disposed to recommend. Now, he was not quite prepared to tell them the precise form that he considered best; but he would recommend the avoidance of apartments of a circular form by all means, as the audience would be overwhelmed by the reverberation of the speaker's voice; the elliptical form produced still greater evils; and, in fact, whether the apartment were intended for music or speaking, it should be divested of all curvature. Neither would he have semicircular rooms, although, if built in this shape, they might be improved, if not effectually cured, by ornamenting the walls with columns and pilasters, by furnishing the windows with drapery, by covering the floor and benches with drugget or carpeting; and if that would not do, he would dissect the ceiling with cross beams, and introduce figures and ornaments in its decoration, so that the sound of the speaker's voice would be broken into a diversity of reverberations. Should all this fail in remedying the inconvenience, he would wainscot the room with wood, from the top to the bottom, by which the number of the echoes would be multiplied *ad infinitum* (?) The Royal Institution was built in a curved form, and would be very bad were it not that it was lined with wood, and furnished in other respects so as to destroy the reverberations which he had described."

Alberti says,—"I will not omit one observation (speaking of the Senate-house), namely, that no place where we are to hear the voices of persons either speaking, singing, or disputing, should ever be vaulted, because such roofs confound the voice with echoes; whereas a flat ceiling, made of timbers, renders the sound more clear and distinct."

And yet the curved form of ceiling is found in some of the best theatres and rooms for hearing in. At her Majesty's Theatre, when rebuilt by Novosielski, great care was taken to avoid projections on the surface of the ceiling, and on every other part,—the whole was kept flat to give as little interruption as possible to the progress of sound; and this is certainly one of the best theatres in Europe for music.* Immediately in the centre of the pit, at a certain distance from the back, there is a very distinct, and, at the same time, disagreeable echo, and you may, in one place here, hear the prompter from his box in the centre of the stage as plainly as you can the singers. We know of no other part of the house, however, where the sound seems in any way confused or interfered with.

The fact is, there are many things which concur to produce a bad or good hearing apartment. Attention to two or three points is not sufficient; and in cases where the more prominent requirements have been attended to without good effect, we should perhaps find on strict investigation a reason for the failure, and so remove what might seem to be a contradiction.

Foremost amongst the less obvious circumstances affecting the conveyance of sounds in a building is the mode of ventilation employed,—the manner in which air is brought in and taken out. The state of the atmosphere in a room will alone cause great difficulty; as may be proved by striking a glass filled with water, and one filled with carbonic acid gas. In the latter case, a dead and leaden sound alone is produced; and the wet blanket, to speak literally, thrown on a singer's exertions by the breath of the audience in an ill-constructed apartment, becomes understandable.

The effect of two or more reciprocating bodies upon a sound is curious. An experiment occurs to us which shewed it forcibly. It was for the purpose of demonstrating that when the vibrating body, which sets the air in motion, is placed between two reciprocating bodies in such a manner, that the vibrations of the air from one of them shall cross the vibrations of the air from the other at *right angles*, the sound ceases; and, on the other hand, that when two such reciprocating bodies are placed so that their vibrations mingle in *right lines*, the

* *Sound.*—In any alteration of the old house, or in the erection of a new one, is it not probable that you will be more successful in having a good sound by having *a circular end* than by having square sides? Yes, you will find that in the Olympic Theatre at Vicenza there is a circular end; so had all the ancient theatres, both Greek and Roman.—Concluded that shape to be peculiarly favourable to hearing.

Sandrke.—Have you considered whether a complete circular shape, a segment being cut off for the 'strangers' gallery, immediately behind where the speaker would be placed, as likely to be favourable for hearing? * * I think if the circular form were preserved behind the speaker, above the proposed seats, it would be a very inconvenient room for hearing; there would be in all probability such a reverberation of the voice, that it would be scarcely possible to hear with distinctness; if the circle is not preserved, but a large segment is taken off by a straight wall behind the speaker, it would still be liable to some of the objections which I have generally observed apply to semi-circular rooms; it would be extremely difficult to prevent the reverberation of sound, and especially when there were but few persons in the room.

* The theatre at Parma is, without exception, the largest in Europe. Addison, in his remarks on several parts of Italy, says, "It is so admirably contrived, that from the very depth of the stage the lowest sound may be heard distinctly in the farthest part of the audience, as in a whispering place." Dr. Moore, in his travels in Italy, observes "that a whisper is heard all over this immense house." This theatre is surrounded on the inside with columns. It is remarkable that Pietro Paulo, in his plan, shews thirteen intercolumniations; Mr. Saunders fifteen; and Patte seventeen; consequently the lengths of the theatre in these plans differ. The last of these writers states that he measured it himself, and remarks that there are seventeen intercolumniations. The theatres at Vicenza and Bordeaux are also surrounded with columns in the same manner, and are stated to be favourable to the progress of sound; how these ornaments in relief will be reconciled with the necessity of a smooth surface, remains to be explained."—WYATT.

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